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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Chemistry and Engineering
Naval Stores Research Division
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Directions for Running Crude Gum on a Turpentine Fire Still

Until recent years the operation of gum turpentine stills in this country was entirely regulated by the stiller whose judgment resulted from listening to the boiling sound at the end of the worm and noting the amount of spirits in a glass of the water-and-spirits mixture caught at the end of the worm.

The Bureau of Agricultural Chemistry and Engineering has, for a long time, urged the use of an accurate recording thermometer on turpentine stills. With such a thermometer an exact record of the temperature in the still during the whole run may be obtained, the temperature in the still can be more exactly regulated, and better grades of rosin can be made.

Whether or not the still has a thermometer, it is necessary to use a glass to catch a sample of the distillate (spirits and low wine) at the end of the worm to judge the proportions of spirits and low wine coming over throughout the running of the charge. The paler rosin is made with greater ease and certainty when both the thermometer and the right kind of glass are used intelligently.

Mr. G. P. Shingler, Senior Chemist in Charge of the Naval Stores Station, Bureau of Agricultural Chemistry and Engineering, has found from practical tests that a glass well suited for this purpose is the large-top, straight-side, 10-ounce nursing bottle. This bottle or glass is marked so that each division, corresponding to one-half ounce, equals one-twentieth or 5 percent of the capacity of the glass. With it the stiller can see at once how much spirits is coming over, and can judge what is going on in the still. Consequently, he is better able to control the fire and water.

To make the best rosin always keep a foam on the gum. This can be done by keeping the water "ahead of the fire." So little water is necessary to form a foam on rosin that many stillers wait too long before turning on the water, and let the charge go practically "flat." The water should be turned on a little before the still actually "calls for water" as may be determined by the "frying" sound at the end of the worm or as may be shown by the proportion of spirits and water in a sample filling the 10-ounce nursing bottle. With a properly marked glass, the exact time to add water can be judged, and there is no guess work about knowing when the spirits is practically all off and it is time to turn out.

When the still starts to run, spirits and water are about evenly divided in the glass. The thermometer should read close to 212° F. It may vary between 209° and 215° F., depending on the class of gum and the quantity of water in the gum. Keep the temperature rising gradually until time to add water. If the still was cooled off with water before charging with gum, as directed in "How to Charge a Turpentine Still" (a copy of which may be obtained from the Naval Stores Station, Olustee, Florida, or from the Bureau of Agricultural Chemistry and Engineering, Washington, D. C.), the time to turn on water will be usually about 35 to 40 minutes after the spirits starts to flow from the worm. During this time the line separating the spirits from the water in the glass, which we will call the "spirits line," will slowly drop to around the 4-ounce mark, then climb to around the 6-ounce mark, and then drop again to near the 5-ounce mark. When this occurs, it indicates that the original water in the gum is nearly out. The "spirits line" should now remain fairly steady around the 5-ounce mark for some time. The size of the stream coming from the worm should remain about the same.

When the proportion of spirits to water increases, that is, the "spirits line" drops below the 5-ounce mark, and the flow slows up, the thermometer will read between 230° and 240° F. with virgin and raised cup gum, and 240° to 250° F. with unraised cup and old gum. Under such conditions, a small stream of water should be turned on, even though the sound at the end of the worm does not distinctly indicate a "call for water." After the still has "called for water" the charge is already starting to go flat, and it takes some time for the water, added then, to mix with the gum and have its effect. Since old gum and gum from unraised cups is harder to control than virgin and gum from raised cups, the water is added to the still for such gum at about 10° higher temperature than for virgin gum.

When water is turned on, the "spirits line" should hold steady between the 4- and 5-ounce lines for some time. If it jumps quickly to the 6-ounce line, there is not enough fire to take care of the water and the still is flooded. If the line drops below 4, the water should be increased to keep the charge from getting flat. Get the still running about half water and half spirits as soon as possible. Keep the fire and water balanced to hold the "spirits line" in the glass between the 4- and 5-ounce marks until the spirits is pretty well off, as shown by the quantity of spirits already distilled, by the temperature (thermometer chart), and the reading on the 10-ounce nursing bottle or the sound of the still. The line will gradually rise to the 6-ounce mark, then to the 7-ounce mark, and to the 8-ounce mark. The temperature curve should show a uniform, gradual climb.

It will probably be necessary to increase the flow of water a little at around 260° to 270° F. When the spirits line reaches the 8-ounce mark, the thermometer should read around 275° F. with virgin and gum from raised cups and 285° F. with old gum and gum from unraised cups. The still should now be tested or checked to determine whether there is the proper balance between the water and fire. This is the second important point of the distillation. Unless the thermometer indicates too much heat and too rapid rise in temperature, increase the fire a little. If the "spirits line" rises rapidly on the glass, the fire was needed. If, on the other hand, the "spirits line" drops below the 8-ounce mark, the fire is too hot -- open the furnace door. If the line holds at 8 for a while, the still is running all right and will gradually come up to the turning-off point.

When the "spirits line" reaches the 9-ounce mark, with the thermometer reading from 285° to 305° F., give the still a little more water. The spirits should continue to come off clear and uncolored, without much variation in the position of the "spirits line." The charge can now be carried along until the "spirits line" gets up to the 9-1/2-ounce mark, providing there is no colored scum noticeable between the spirits and the water.

When the sound and the proportion of spirits in the glass indicate that the turpentine is nearly all off (about 10 minutes before time to uncap), decrease the flow of water into the still in order to get the temperature up to the turning-out point. At 315° F. for virgin, raised, and second-year unraised gum, and at 320 to 330° F. for old gum and gum from unraised cups, cut the water off entirely, pull the fire, uncap, and turn out as directed in "How to Discharge a Turpentine Still " When the still is uncapped, the spirits should show not more than 10 percent on the glass, the "spirits line" should be between the 9- and 10-ounce marks, and the spirits should not be colored. If proper balance between fire and water has been maintained throughout the charge, the "spirits line" may be brought up to 9-1/2 before uncapping.

Without the full flow of water at the end of the charge, the spirits will become discolored, which is an indication that the rosin is being overheated. It is not necessary to leave a great deal of turpentine in the rosin to make a good grade.

If the spirits starts to come over slightly colored, with a brownish scum noticeable when the "spirits line" reaches the 9-ounce mark, more spirits will be obtained only at the expense of the grade of the rosin. With high-grade rosin especially it is advisable to draw the rosin at this point.

Do not depend entirely on the spirits in the glass. If the glass overflows or if there is a leak in the worm, the glass will be misleading.

A leaky worm will show too much water in the glass. Mend the leak as soon as possible. In the meantime, the leak should be tested to see just how much water will be caught in the glass in the time it takes to fill the glass while the still is running. For instance, if one-half ounce is caught in the time required to fill the glass when the still goes to water, turn on the water at 5 instead of waiting until the "spirits line" gets down to 4-1/2. At the end of a charge a leaky worm will cause the "spirits line" to rise to 9 or 9-1/2 when in fact it should still be below that level. This would lead to uncapping and turning out too soon.

One cannot depend entirely on the sound of the still. The recording thermometer is the only reliable means of knowing how hot the still is. Even with a recording thermometer, the graduated nursing bottle will be helpful in bringing the charge steadily and slowly up to the "spirits line" at 9 and finally to 9-1/2, if spirits continues to be uncolored.

The final temperature at which the rosin is drawn must be governed by the kind of gum being run. Clean yearling raised, virgin, unraised 2 years, should be ready, with the spirits all off, at 315° F. Dirty or very old gum will require a higher temperature to strain properly -- 320° to 330° F.

Water should be added to virgin or raised gum, with the "spirits line" at the 5-ounce mark, at 230° to 240° F. Unraised yearling and older gum will be ready for water at 240° to 250° F. At 250° F., virgin or raised gum will probably need more water, as shown by a drop in the "spirits line" to the 4-ounce line. Don't let the line drop below 4, or the grade of the rosin may be lowered.

Unraised yearling should be ready for more water at 260° F and older gum at 270° F. These also go flat if the "spirits line" falls as low as 3. Third year unraised and old gum would be ready to turn out at 320° F. to 330° F. In all other cases, discharge at 315° F. Watch for the scum on the glass at the "spirits line."

Care should be taken not to run the still too fast. The average time for stilling ten barrels of crude gum on a Government-style fire still is about 2-1/4 hours. The maximum rate of flow of turpentine during such runs is about two gallons per minute. By operating the still in this manner, a good turpentine suitable for all uses can be made.

NOTE: If the charge is skimmed when the still goes to water, pull the fire when the "spirits line" gets to 5. After recapping and firing up, turn on the water and finish the charge according to directions for distilling after "going to water." (See directions, "How to Discharge a Turpentine Still.")

THERMOMETER ADJUSTMENT: On every charge when the still starts to run, read the thermometer to determine whether it is in good working order. It should read 212° F., or probably between 209 to 215° F. Instruments off more than 5 degrees, if they cannot be adjusted, should be sent in to the factory for correction or repaired by an expert.

TURPENTINE STILLING CHART

	"Spirits Line" is at	Temperature and Remarks
At start of distillation or soon after	5	(209-215° F.)
Then spirits may drop to	4	Note: When spirits starts to run, the thermometer should record between 209-215° F. If it does not, see directions.
Later "spirits line" rises to	6	
After about 30 minutes "spirits line" again goes to	5	
Still should run this way until original water is nearly out.		
Turn on small stream of water at	5 to 4-1/2	(230-240° F. for virgin and raised.)
	4-1/2 to 4	(240-250° F. for older.)
Still should speed up with "spirits line" holding at	4 to 4-1/2	
If "spirits line" quickly rises to	6	Cut water and increase fire; still is flooded.
If "spirits line" drops below	4	Increase water; still is flat; colored scum may be seen in glass.
Get "spirits line" back to	4 to 4-1/2	(The temperature curve should show a uniform, gradual climb.)
Following this with proper temperature rise, the "spirits line" gradually goes to	6	
Then to	7	
And then to	8	(Temperature should be 275-290° F.)
Increase fire to see whether fire and water are right. If "spirits line" rises, fire is right. If "spirits line" drops below 8, the fire is too hot -- open furnace door.		
"Spirits line" should gradually rise to	9	(285-305° F.)
Now increase water a little; "spirits line" should not vary.		
If no scum appears and spirits continues to come over clear and uncolored, let rise to	9-1/2	
If spirits shows yellow color or brown scum appears, especially with high-grade gum, don't force the "spirits line" above	9	

Finally, decrease flow of water and bring to turning-out temperature:

Virgin, yearling, and raised	315° F.
Unraised 2nd year	315° F.
Unraised 3rd, 4th year	315-320° F.
Old dirty gum or scrape	320-330° F.

If virgin, yearling, or raised gum contains an excessive amount of fine sand or soot from burned-over woods, the turning-out temperature can be 330° F. without injury to the rosin, provided a foam is maintained. This will give a better strain.